Taxes, Natural Resource Endowment, and the Supply of Labor: New Evidence

Belkacem Laabas
Weshah Razzak

API/WPS 1005

Correspondence

Dr. Belkacem Laabas , The Arab Planning Institute, P.O. Box: 5834 Safat. 13059 Kuwait, Tel: (965) 24843130, Fax: (965) 24842935, E-mail: belkacem@api.org.kw.

Dr. Weshah Razzak, The Arab Planning Institute, P.O. Box: 5834 Safat. 13059 Kuwait, Tel: (965) 4843130, Fax: (965) 4842935, E-mail: weshah@api.org.kw.

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Abstract

Using the work – leisure choice model, this paper computes equilibrium hours-worked for a number of Arab, non-oil-producing and labor-abundant countries and major oil-producing, tax-free and labor-scarce countries, for which actual data are unavailable. We estimate hours-worked for the G7, and show that the model fits the data well. We use this evidence as a yardstick to evaluate the model for the Arab countries for which no actual data are available. The model explains hours-worked in Arab, non-oil-producing countries well, but it fails to explain hours-worked in the oil-producing – tax-free countries. With the effective marginal tax rate close to zero, hours-worked increase significantly. We show that natural resource endowment is a required predicting factor for the model in this case. It turned out that natural resource capital acts exactly as a tax. In other words, it increases the wedge between real wages and marginal productivity, hence, natural resource wedge. The higher the natural resource endowment the less hours people worked. Most importantly, we provide a wider support to the model and confirm that the labor supply is elastic in all Arab countries. This finding confirms previous research that workers respond to incentives, which has serious implications for tax and social security policies. We also provide some policy simulation pertinent to poverty and welfare.

الضرائب، الموارد الطبيعية وعرض العمل

ملخص

في هذه الورقة نقوم بحساب عدد ساعات العمل الأسبوعية للفرد العامل في عدد من الدول العربية النفطية ذات العمالة الشحيحة وغير النفطية ذات العمالة الفائضة والتي لا تتوفر لديها بيانات بهذا الخصوص. ولغرض تقييم نتائج النموذج الاقتصادي نقوم بمقارنة النتائج مع تلك التي حسبناها للدول الصناعية السبعة الكبرى. وجدنا بأن النموذج يعطينا نتائج معقولة بالمقارنة ولكنه يفشل في حالة الدول النفطية، إن سبب الفشل هو كون الدول النفطية ليس فيها ضرائب ومعدل الضريبة الفعلي هو عامل أساسي في هذا النموذج لتحديد عدد ساعات العمل. وعليه، فقد قمنا بتحوير النموذج بإدخال الثروة النفطية كنسبة من الناتج القومي باعتبارها جزء مهم من راس المال وعليه تؤثر على مستوى الإنتاج. ووجدنا بأن الثروة النفطية تعمل عمل الضريبة حيث أن ارتفاعها يؤدي إلى تقليل عدد ساعات العمل ويخلق فجوة بين الأجر الحقيقي وانتاجية الحدية. إن الدول النفطية دول ريعية. عندما يزداد سعر النفط تزداد الواردات ومعه يزداد الريع مما يجعل الناس يفضلون السعي وراء الريع على العمل. إن هذه الورقة أيضاً تجد عرض العمل في الدول العربية مرناً وتقدم دعم لهذا النموذج حيث أن هذه النتيجة تؤيد بأن العامل يتأثر بالحوافز ولهذا تبعات على مستوى صياغة السياسات المالية وخصوصاً سياسات الضمان الاجتماعي. بالإضافة إلى كل هذا تقدم هذه الورقة سياستين، الأولى عن كيفية تقليل الفقر والثانية حول زيادة الرفاه الاقتصادي. واخترنا المغرب لدراسة كيفية تقليل الفقر حيث هناك 20% من السكان تحت خط الفقر. وبيّنا بأن السياسة المالية التي تسعى إلى خفض معدل الضريبة الفعلي من 39 إلى 30 بالمئة يمكنها من خفض معدل الفقر إلى نصف ما هو عليه خلال 12 سنة. أما بخصوص الرفاه الاقتصادي فإن فكرة زيادة استحداث ضرائب على الاستهلاك في دول الخليج ستؤدي إلى انخفاض في معدل الرفاه للفرد.

1. Introduction

Our primary objective is to provide information about the labor market such as hours-worked, the Frisch elasticity of labor supply, and labor productivity in a number of Arab countries. Without such information the discussions about labor, fiscal, social security, welfare and poverty policies, among others, would be misguided.

We focus on the macroeconomic implications of policy issues. Data limitation dictates research methodology. We calibrate a theoretical model, namely, the work – leisure choice model, which Nickell (2003), Prescott (2004) and Shimer (2009) demonstrated its goodness of fit to G7 data.[1] This is a simple and informative model, where the Arabic data of the main predicting factors are available, albeit with dubious qualities.

The main challenges are that data on hours-worked for the Arab countries are not available, which makes assessment of the goodness of fit of the model difficult. And, some of the Arab countries, namely the Gulf Cooperation Council countries (GCC) oil and gas producers are almost tax-free economies. With the effective marginal tax rate close to zero, the model predicts a very high, nonsensical, labor supply.

To deal with these challenges we fit the model to the G7 data and use that as a yardstick to assess the goodness of fit of the model to the Arab countries. For the group of the oil-producing countries, we introduce natural resource endowment, into the model. It turned out that the natural resource capital creates a wedge between real wages and the marginal product of labor similar to the *tax* or *labor wedge*. The increase in the share of natural resource reduces hours-worked. It discourages work and reduces labor supply because rent-seeking activity increases with relatively high hydrocarbon revenues.

The GCC countries are rent-economies, Noland and Pack (2007). When hydrocarbon revenues as a percent of GDP increase because of the increase in energy prices, oil-rich governments run expansionary fiscal policies, and distribute rent in proportion to revenues. Handouts of goodies take several different forms such as contracts, concessions to friendly domestic and foreign businesses and speculators, bureaucratic jobs and higher wages to citizens, most of them don't even show up for work. On average, equilibrium hours-worked is expected to be lower in the state of the world, where hydrocarbon revenues are high. And when energy prices drop, hydrocarbon revenues decline and the rent shrinks, which motivate households to work longer hours to compensate for the loss of income from rent, and to smooth consumption, hence a higher equilibrium hours-worked. These are the manifestations of the resource curse in the labor market. For the resource curse see for example, Sachs and Warner (1997), Leite and Weidmann (1999), Caselli and Michaels (2009).

We make a number of contributions. First we compute hours-worked for five Arab non-oil producers (Egypt, Jordan, Morocco, Syria, and Tunisia) and for seven oil-producers (Algeria plus the Gulf Cooperating Council group – the GCC – of Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates (UAE) and the Kingdom of

Saudi Arabia (KSA). This allows us to compute and analyze the Frisch elasticity of the labor supply, which plays a major role in policy design. And, also allows us to shed light on productivity in the Arab countries relative to the G7. Second, we are unaware of any published article on the work – leisure model with a natural resource endowment. We modify the model and show that such endowment works just like a tax on labor supply. Third, we confirm the validity of the work-leisure intertemporal – intratemporal substitution model using Arab countries' data. A theory is most valid if it fits different data at different times. So far, the bulk of the evidence for the work – leisure model relies on data from developed countries. We show that Arab countries' labor supply curves are just like the G7, also elastic, which has important policy implications.[2] Non oil-producing Arab countries work long hours, but their relative productivities are low, thus they are relatively poorer. Oil-producing countries work much less. So the relatively less fortunate Arab countries work hard while the oil-rich countries are hardly working, especially when oil revenues are high.

Finally, we solve the model stochastically and produce baseline projections of future labor supply for the Arab countries. Then we conduct policy scenarios. First, for the GCC countries we ask how much is the change in welfare if the GCC countries embark on a diversification policy, which reduces the reliance on oil as the main source of income? We find very significant increases in the lifetime consumption equivalent. Second, we ask how much is the change in welfare due to the introduction of a permanent consumption tax? Finally, how long it will take to eliminate poverty if a policy to reduce the tax rate on household is adopted in non oil-producing countries? We find that a small permanent tax cut can reduce poverty by more than half in about 12 years.

The model is presented next. In section 3 we produce and discus the results. Section 4 includes policy simulations. Section 5 is a conclusion.

2. The Model

We begin with the model found in Prescott (2004) to derive the labor supply.[3] A similar model is presented in Nickell (2003) and Shimer (2009). Then we modify the model to include natural resource endowment.

The utility function of a *stand in household* who faces a work – leisure decision is give by:

$$(1)\quad U = E\left\{\sum_{t=0}^{\infty}\beta^t[\log c_t + \alpha\log(100-h_t)]\right\}$$

The utility function depends on the expected discounted sum of consumption c and leisure, where 100 is the number of hours available for individuals to work in a week and h is hours work in "market activities". The expectations operator E does not necessarily mean rational expectations, and $0 < \beta < 1$ is the discount factor specifies the degree of patience. A high value means more patience for consumption and leisure. The parameter α is > 0 and denotes the value of the non-market productive time for household. Maybe it is the relative value of the time spent in working at home. Typically, it is the relative value of leisure. The production using this time is untaxed. The utility function includes one consumption good as in Christaino and Eichenbaum (1992). We find no contradiction of such assumption with reality in the Arab countries.

The stock of capital evolves according to:

$$(2) \quad k_{t+1} = (1-\delta)k_t + x_t$$

Where k is the stock of capital and x_t is gross investments. The depreciation rate is δ.

There is a *stand-in firm* with a Cobb-Douglas constant returns to scale technology of production:

$$(3) \quad y_{it} = A_{it} k_t^{\theta} h_t^{1-\theta} \geq c_t + x_t + g_t$$, where g is government expenditures.

Total factor productivity is *exogenous* given by A_{it}, where i is country $i = 1,2,\cdots n$.[4] The parameter $0 < \theta < 1$ is the share of capital.

It is argued that the technical progress is exogenous because it plays no role in the inference being drawn.

The household's date t budget constraint is:

$$(4) \quad (1+\tau_c)c_t + (1+\tau_x)x_t = (1-\tau_h)w_t.h_t + (1-\tau_K)(r_t - \delta)k_t + \delta k_t + T_t$$

Where w is the real wage, r is the real interest rate or rental capital, and T is transfer payment. The tax rates of consumption, investments, labor, and capital are given by τ with the subscripts c, x, h, k denote consumption, investments and capital respectively.

There is a literature on the methods of estimating average marginal income tax rates in the US, where differences seem significant. Differences in the computation of income tax rates could affect the tax rate τ in model. For more on the debate, see Barro (1979), Seater (1982), Barro and Sahasakul (1983, 1986), Stephenson (1998), and Akhand and Liu (2002).

Prescott (2004) derives the tax rate in the model theoretically. See appendix 2 for details. He derives an aggregate effective marginal tax rate on labor income using both the tax rate on consumption τ_c and on labor τ_h. It is the fraction of additional labor income that is taken in the form of taxes, holding investments fixed.

$$(5) \quad \tau = \frac{\tau_h + \tau_C}{1+\tau_C}$$

It is also important to note that the marginal and the average labor income taxes are very different. All tax revenues, except for that used to finance the pure public consumption, is given back to households as lump-sum transfer payments (independent of the household's income). Note that the model economy's consumption in the utility function above is $c = C + G - G_{mil} - IT_c$, where G is public consumption and G_{mil} is military spending. And the model economy's output in the production function is $y = GDP - IT$.

In the Arab countries, public consumption is large, and so is the subsidy. In some Arab countries, only total amount of subsidy is reported, which is the sum of production and consumption goods subsidy. We had to make an assumption on splitting them. The data appendix includes more information.
From the above we get the F.O.C., then the marginal rate of substitution equal to the price ratios:

$$(6) \quad \frac{\alpha/(1-h_t)}{1/c_t} = (1-\tau)w_t$$

And from the production function, the marginal product of labor is equal to the real wage rate:

$$(7) \quad w_t = (1-\theta)k_t^{\theta}h_t^{-\theta} = (1-\theta)y_t / h_t$$

The equilibrium labor supply is solved for from the two FOC above,

$$(8) \quad h_{it} = \frac{1-\theta}{(1-\theta) + \frac{c_{it}}{y_{it}}\frac{\alpha}{1-\tau_{it}}}$$

The subscript denote country and the subscript t denotes time. The parameters which do not have subscripts will be calculated as the *average* across the countries in the sample, and fixed throughout unless stated otherwise. For example every country will have a fixed value of θ in equation 8 equal to the average of θ across the countries. The intertemporal substitution is captured by the ratio of consumption to GDP in equation 8. The intratemporal substation is captured by the tax rate in equation 8. If the effective tax rate on labor income is expected to be lower in the future, for example, people will increase their current consumption.

2.1 Introducing natural resource endowment effect

For the GCC countries and Algeria, the theory predicts that a low tax rate τ increases hours work. If we fit the model for the GCC, hours-worked will be very high, higher than the US and Japan. To ameliorate this problem we modify the model by introducing oil endowment.

Let the "effective" stock of capital be k_t^*, and $k_t^* = m(N)k$, where m is an amplification factor, N is natural resource capital and K is the stock of capital. We assume that $k_t^* = N_t^{\omega}k_t^{\theta}$, where N is the stock reserves of both oil and gas. The production function becomes:

(9) $y_t = A_{it} N_t^{\omega} k_t^{\theta} h_t^{1-\omega-\theta}$

Solving the model the same way results:

(10) $$h_{it}^{N} = \frac{1-\omega-\theta}{(1-\omega-\theta)+\frac{c_{it}}{y_{it}}\frac{\alpha}{1-\tau_{it}}}$$

We call it h^N, where the superscript N refers to natural resources. The share of hydrocarbon in output is ω. For ω>0 this formula predicts that $h^N < h$ in equation (8). For ω=1, h^N <0 and for ω=0, h^N is identical to h.

3. Calibration

The data are fully described in the appendix. Note that our data are measured in PPP term so they are larger in magnitudes than actual data. The data for the Arab countries have dubious quality. One problem is missing data. We use averages over the period 1999 to 2006 to calibrate the model, but for some countries the averages are for less than the full sample. Consumption data are also dodgy. These are residuals of the equation of exchange or the income identity.

Table 1 includes our estimates of hours-worked for the G7 for the period 2000 to 2008. The fit of the G7 is our yardstick for the goodness of fit of the model for the Arab countries because Arab countries do not report hours-worked.

The countries are listed in the first column. The second column reports actual hours-worked. We fix the value of α, the relative value of leisure, to the average of the G7, and to get the best fit. For our sample α is 1.78. We also took the average share of capital θ to be 0.38. We computed the share of capital from National Income Accounts, as gross operating surplus / GDP ratio. The predicted hours-worked are reported in the third column. The fourth column reports the difference between the actual and the estimated values. The model fits Canada, Italy, and Japan best; slightly over-predicting in the case of Canada, and slightly under-predicting in the cases of Italy and Japan. On average, however, the fit is fine with a difference of 0.06 only. The G7 average weekly hours-worked per person is about 23.

The fit can be made tighter when we allow α to vary across countries. We report the different values for α in table 1. Allowing α to vary across the G7 countries shows that the Italy has a value of α right on the average of 1.78. Three countries Canada, the UK, and the US have a value of α equal 1.6, which is below the G7 average. The non-English speaking countries France, Germany and Japan have a value of α higher than 2. The relative value of leisure is much higher in the non-English speaking G7 countries.

Now we can turn to estimating hours-worked for the Arab non-oil producing and labor abundant countries. We compute the tax rate the same way we calculated them for the G7, and as we explained in the appendix. Note that there are no time series data for the marginal tax rates for Arab countries. We also conduct a sensitivity analysis. The share of capital, θ is fixed to the average of the Arab countries at 0.48. For the Arab countries we try α of 1.78.

We have no actual data for the Arab countries, but the prediction of the model seems sensible. The average weekly hours-worked per person is 19.87, which is lower from the G7 average of 23.4. Beginning with most obvious, the Syrians work much more than all other countries (26.1hours) because they pay the lowest tax rate among Arabs and their average propensity to consume is less than average G7. Egypt's estimate of hours-worked is less than Jordan's even though the Jordanians have a higher tax rate than the Egyptians. This is because the consumption – output ratios are quite different. The Egyptians consumption to output ratio is 0.98 while Jordan is 0.79. Egypt's consumption to output ratio exceeds the G7 average by far. All Arab non oil-producing countries have a high consumption to output ratio, far exceeding the developed countries in PPP terms. The North African nations, Tunisia and Morocco work less than the Syrians and the Jordanians because they pay relatively more taxes than other Arabs. Morocco and Tunisia's average weekly hours – worked are approximately 17.

The results in table 1 confirm the literature's findings that when people are taxed the same rate they, they most probably supply the same amount of labor, everything else is the same. Taxes affects labor supply decision in the Arab countries.

Our estimates of the Frisch elasticity in table 1 suggest that the labor supply curves for the Arab countries are elastic, more so in Egypt, Morocco and Tunisia. These Frisch elasticity estimates support the literature's. Fairly elastic labor supplies spares countries the trouble of facing the cruel choice of either increasing taxes on the young, thereby reducing their welfare, or not honoring the promise made to the old making them worse off. One thing large labor supply elasticity means is that as population age, promises of payment to the current and future old people cannot be financed by increasing taxes.

Our estimates of the labor supply can explain why the non-oil producing Arab countries have low productivity. There should be no problem with working less hours if efficiency and productivity are high. However, this is not the case for the Arab countries. Table 2 reports the decomposition of income per working age population relative to the average G7, GDP per working age population is decomposed to: GDP per hour and hours per working age population, i.e., labor productivity times labor utilization. The Arabs do not seem to have a lot of problems with labor utilization. They work long hours, but their relative productivity level is significantly low. The Arabs work hard, produce relatively less output per hour, and they are poorer than the G7. Any increase in the tax rate in the Arab non-oil producing countries will make them even poorer.

Now we turn to the oil-rich and labor-scarce Arab countries. These include the GCC countries plus Algeria. The GCC effective marginal tax rate is very low, about 5 percent compared to Algeria, which is 34 percent. GCC countries have only social security tax of about 5 percent, no income tax and no consumption tax. We estimate hours-worked over two samples. The first sample is when the price of oil was low, hence oil revenues to GDP were low. The second sample is when the price of oil was high, hence the revenues to GDP were high. The theory predicts that households will increase their supply of labor in periods of low oil revenues and low rent.

The share of hydrocarbon in GDP ω is taken from the budgets. It is basically the ratio of oil and gas revenues $p^o q^o /(p^o q^o + p^{no} q^{no})$ where the superscript o denotes hydrocarbon (oil and gas), hence p^o is the price of the hydrocarbons and q^o is the quantity. And, the superscript no denotes the non-hydrocarbon.

Results of the estimates of the GCC and Algeria are shown in table 3. For sensitivity analysis, we use values of α 1.3 and 1.5 and also 2.0. The average predicted equilibrium weekly hours-worked in the GCC is between a high of approximately 20 hours and a low of 13, during the sample when oil revenues as a share of GDP were low, which is a sensible figure compared with previous estimates of the G7, and Arab non-oil producing countries. This average is lower than the average of the non-oil producing Arab countries. Algerians work slightly longer hours than the average GCC, but less than Bahrain. Bahrain, Oman and the UAE predicted weekly hours-worked exceed the average GCC. They also work harder than the average Arabs. The citizens have higher labor participation rates and more involvements in the labor market than other GCC countries. Bahrain and Oman in particular, implement active labor market policies to reduce unemployment and get their citizens to work. Kuwait, Qatar and Saudi Arabia work relatively less hours than all other Arab countries, whether oil or non-oil producing. These three countries are major oil and gas producers.

In the second sample over the period of high hydrocarbon revenues, hours-worked plummet just like the theory predicts. The average falls somewhere between 7 and 5 hours. Algeria's hours fall between 7 and 5 hours. Among the GCC, Oman's hours-worked decline is the largest, between 12 and 8 hours. On average, GCC hours-worked could decline by 5 to nearly 8 hours due to higher hydrocarbon revenues. That says a lot about the extent of the rent in these economies and reflects the manifestation of the oil curse in the labor market.

We solve the model for the effective marginal tax rate τ for the G7 and for ω in the GCC, i.e., the *resource wedge* . Figure 1 plots the *tax wedge* for the G7 and the *resource wedge* for the GCC. The averages over the sample 1991-2006 are 0.41 and 0.36 for the GCC and the G7 respectively. The natural resource wedge works the same way the tax wedge works: it increases the wedge between real wages and the marginal product of labor, and away from perfect competition in the labor market.

To confirm that the estimates of labor supply are highly sensitive to the tax rate, we report estimates with different tax rates. In Prescott (2004) the marginal tax rate $\tau_h = t_{ss} + 1.6\overline{\tau}_{inc}$, where τ_{ss} is social security tax and τ_{inc} is the marginal income tax. The number 1.6 reflects the fact that the marginal income tax rates are higher than the average tax rates, and the number delivers a marginal income tax found in Feenberg and Coutts (1993) for the "US". Their calculation of the marginal income tax is based on a representative sample of tax records. They calculate by how much the tax revenue increases if every household labor income is increased by one percent. The total change in tax receipts divided by the total change in labor income is their estimate of the marginal income tax. We play with this number, and recalibrate hours for values of 1, 1.6, 2.6, and 3.6. We prefer the central estimates because we believe the estimates are neither very low nor very high. It is inconceivable that the tax rates are above 40 percent in the Arab countries (see appendix 2).

Our paper does not include the effect of the population dynamics. We know from various empirical evidence that demographics play a major role in the study of labor supply. Noland and Pack (2007) provided demographic statistics for the Arab countries, which show that (1) population growth slowing down, (2) fertility rates falling, (3) median population age is projected to rise, (4) female labor force participation trending up and projected to reaching 60 percent in many Arab countries by 2020. The supply of labor will be probably increase in the future.

4. Policy simulations

4.1 Diversification, consumption tax and Welfare in GCC

We provide a baseline stochastic projections for hours-worked until 2050. Then we simulate policy scenarios. The first policy scenario is about the welfare effect of taxes. We study the effect of a reduction in the share of oil in GDP in the GCC as a result of a policy that aims at diversifying income.

We examine the effect of a permanent reduction in the share of hydrocarbon in GDP, ω by an amount equal to 0.25 standard deviations. We assume that the GCC countries have successfully managed to diversify their economies away from hydrocarbon by the year 2020, hence a permanent reduction in the share of oil and gas in GDP from the year 2021 to 2050 (the end of our simulation). The share of oil and gas revenues as we stated earlier is $\omega = p^o q^o / (p^o q^o + p^{no} q^{no})$. Diversification means a reduction in the value of ω coming through an increase in $p^{no} q^{no}$ (the non-hydrocarbon output), thus higher share of labor in the production function and a lower share of natural resources. The increase in labor supply increases output and consumption.

The welfare effect of the policy is measured by the *lifetime consumption equivalent,* which is the change in real consumption required to make the households indifferent to the policy.

We solve the model numerically over the period 2004 to 2050 using stochastic simulation with 10000 iterations.[5] The parameters $\alpha = 2$, $\theta = 0.51$, which is the average value of GCC over the sample 1991-2003, ω is assumed to be a random walk process over the forecasting period; the error term has a mean of zero and a standard deviation equal to the sample value. To simplify the solution of the model further we appeal to the stochastic implications of the lifecycle – permanent income theory of consumption and assume that the conditional expectations of the future marginal utility of consumption follows a random walk (Hall, 1978). Working age population grows at historical trend. The capital stock's starting value is assumed to be twice the size of real GDP in 1960. The depreciation rate was assumed to be 0.05. The value of the exogenous technical change A in the production function is the constant term, and calibrated such that the value of output in 2004 is not far away from 2003 to make sure we have a sensible projection.

Baseline level of consumption is estimated to be increasing in all GCC countries, but leveling off in the far future. The consumption to output ratio projection depends on the projected level of output from the production function. In the baseline solution, Bahrain's ratio has a negative trend suggesting that output is projected to increase by more than consumption. This ratio rises in Kuwait, Oman, and KSA. The most significant positive trend is in KSA. The ratio is constant in the UAE.

The second policy simulation introduces a 5 percent permanent value added tax (consumption tax τ_c in the GCC on welfare, which translates to a 9.5% increase in the tax rate τ (equation 5).

The results of the two policy simulations are reported in table 4. We report the averages of the share of hydrocarbon in GDP ω; the standard deviation of ω; and the consumption to GDP ratio over the sample from 1991 to 2003. In the second panel, columns 5, 6 and 7 report the average projected hours-worked, the value of the share of hydrocarbon. In the third panel, columns 7, 8, 9 and 10 we report the results of the first policy, policy I. In column 10 we quantify the policy of a $0.25\sigma_\omega$ reduction, in US dollars. And in the last three columns we report the results of the second policy. Note the jump in the labor supply under policy I. The reduction in the hydrocarbon revenues is very small because we just wanted to show the welfare impact of a small change in policy. The reduction is 0.1 on average and about 1.4 billion US dollars. This reduction in hydrocarbon revenues is matched by an equal reduction in government spending to keep the budget constraint unchanged. We assume that the government can reshuffle the budget in any different way it likes.[6]

Table 5 reports the lifetime consumption equivalent of the two policies. Clearly, the welfare improvement which results from the diversification policy and measured in lifetime consumption equivalent is positive and sizable. In the case of Oman, it is 14 percent, followed by Qatar 10.8 percent and Kuwait 9.3 percent. The lowest is Saudi Arabia. The Kingdom of Saudi Arabia has a relatively better diversified economy than other GCC countries. The share of manufacturing and agriculture in GDP are reasonably high. The World Bank Development Statistics reports Saudi Arabia's agriculture, manufacturing and services value added in the total GDP in 2008 to be 2.3, 8 and 27.2 percent.

Bahrain, the smallest oil producer. Bahrain main source of income is not oil. Its welfare improvement from the diversification policy is equal to that of Saudi Arabia. In the UAE, the welfare improvement measured by lifetime consumption equivalent is 5 percent, the third lowest. The share of agriculture, manufacturing and services value added in 2006 reported by the World Bank Development Statistics are 2, 12.25 and 39.11 percent respectively. Qatar, Kuwait and Oman benefit the most from diversification. Qatar and Kuwait rely heavily on hydrocarbon revenues. The Kuwaiti data are available from the same source for 2003 only. The shares are 0.46, 2.27, and 48.5 percents. We do not have similar data for Qatar and Bahrain.

For policy II, an introduction of a permanent 5 percent VAT reduces welfare by around 4.6 percent in terms of lifetime consumption equivalent. The positive change in the labor supply resulting from the diversification policy is larger in magnitude than the negative change resulting from the tax policy. One can only imagine a sizable welfare effect of a policy change larger than 0.25 standard deviation in hydrocarbon share in the economy. The point is clear. Diversify and benefit.

4.2 Tax policy, labor supply and poverty reduction

Finally, we discuss the policy simulation pertinent to poverty reduction in the Arab countries. A decrease in the tax rate or the effective marginal income tax rate would increase the supply of hours, GDP, and reduces poverty. The policy simulation is intended to provide a feel for this policy recommendation. We want to answer questions such as, how long would it take to reduce or eliminate poverty?

We choose Morocco as a case study for poverty for two reasons. Morocco's poverty level is high, 21 percent of the population. And because we have some data on income distribution. The poverty data are based on the World Bank data found in POVNET for the year 2007 only and the base year for real expenditures is 2005. For this reason we use data for real consumption and output from the Penn Table 6.3, which has data up to 2007 for Morocco and the base year is 2005.

We solve the model over the period 1991-2006, and simulate the model stochastically with 10000 iterations over the period 2008 to 2040. In the baseline solution, τ the effective marginal tax rate is equal 0.39. We set α to 1.78, which is the average we used earlier, and the share of capital θ equal to 0.55 which is also the average over the sample. Here too we guess that the capital stock's starting value is twice the size of real GDP in 1960. The depreciation rate was assumed 0.05. Consumption is assumed to be a random walk, with a standard normal error term of a zero mean and standard deviation equal to the that of the sample average from 1991-2007. The value of the exogenous technical change A in the production function is the constant term, and calibrated such that the value of output in 2008 is not far away from 2007 to make sure we have a sensible projection. The policy reduces the tax rate to 0.30 permanently.

The simulated values of real consumption is used to compute poverty headcount. There are three parameters in the poverty function: mean real consumption expenditures; Gini coefficient; and the poverty line. The poverty line is fixed at 72 US dollar per household per month in PPP term. The Gini coefficient is fixed. The only parameter that changes is mean real consumption expenditure, which is updated over the simulation period. We report the results in table 6. Figure 2 plots the poverty reduction dynamics.

Clearly, poverty could be reduced significantly. As income level rises and growth rate of real consumption rises poverty can be cut by more than half in 2020, i.e., in 12 years. Poverty can be eliminated by 2050. One can clearly advocate more tax reduction than the one we assumed, and cut poverty even faster and by more.

5. Conclusion

The work- leisure model of the labor supply has been tested extensively in the literature, and the majority of evidence seems to support its predictions. This paper uses data from Arab countries to confirm the predictions of the model and add to the existing evidence yet another supporting evidence. The supply of labor is elastic.

There are two types of Arab countries. One consists of non oil-producing and labor abundant countries such as Egypt, Jordan, Morocco, Syria and Tunisia. The other includes major oil-producing and labor-scarce countries such as the Gulf Cooperation Council (GCC). Algeria is a major oil and gas and producer, but not a labor-scarce country. While the model explains the data of the first group of Arab countries well, where results are comparable to the G7, the second group of Arab countries is more interesting because there are no taxes in the GCC countries. Without taxes the model's performance and predictions are of limited values. To ameliorate this deficiency we introduce natural resource endowment effect in the work-leisure model. We define effective capital as the product of physical capital and natural resource capital. We found that natural resources endowment acts like a tax, i.e., reduces labor supply.

The theory we had in mind is consistent with the resource curse story. Oil rich GCC countries rely heavily on their natural resources as income. The government budget swells during periods of high hydrocarbon (oil and gas) prices, which beget rent-seeking behavior. People spend the time looking for goodies, gifts, contracts, wage subsidy…etc and eventually labor supply declines. The opposite happens when hydrocarbon revenues decline and the budgets shrink. People are forced to work longer hours to compensate for the loss in rent, and smooth out consumption. We show that the data support such theory over periods of actual high and low hydrocarbon revenues. The supply of labor could decline by up to 7 hours a week per person during periods of high oil revenues.

The Arab countries labor supplies are very elastic, more so in the oil-producing countries. An elastic labor supply could imply less interventionist government policies. And as population age, transfer payments to current and future old generation need not be financed by increasing tax rates. It can open doors to social security policies that encourage savings, Prescott (2004). Elastic labor supplies are also good for demand policies that aims at increasing employment and hours.

We simulate the model for scenarios under a minimum number of additional assumptions. We demonstrate that a reduction in the effective marginal tax rate in the Arab countries can reduce poverty substantially, cut it in half in about 12 years in the case of Morocco.

High taxes, even a 5 percent increase in the value added tax (VAT) in the oil-rich countries would reduce welfare in terms of the lifetime consumption equivalent. But most importantly we show that the resource rich countries increase welfare significantly from a decline in oil revenues. To change the natural resource curse to a blessing the GCC is strongly advised to diversify its income away from oil while it can. Our model and simple assumption indicate that a permanent reduction of hydrocarbon in the year 2020 could increase labor supply, real GDP and consumption leading to a significant welfare improvement.

Footnotes

(1) Prescott (2004) provide evidence that – everything else constant – significant differences in international hours-worked almost disappear when tax rates are similar. Scandinavians pay relatively more taxes. Ragan (2006) and Rogerson (2007) argued that Scandinavian governments subsidize market inputs into home production and provide more transfers (e.g. subsidized daycare) to households that supply more labor. Olovsson (2009) use home production data to account for the differences in hours-worked between Scandinavians and others.

(2) Lucas and Rapping (1969), Hall (1980), Andrew and Nickell (1982), Alogoskoufis (1987a, 1987b), Dutkowsky and Dunsky (1996), Nickell (2003), Prescott (2004), and Shimer (2009) among many others provided evidence that support the model. Card (1991) cited a number of surveys at the micro level, which seem to suggest that the intertemporal substitution proposition offers little explanation to labor supply decisions. Heckman (1993) cited more supportive evidence. The literature is voluminous, but most cited work evidence against the intertemporal substitution model are, Altonji (1982), Mankiw, Rotemberg and Summers (1985)

(3) Prescott cites a number of papers as the basis of this theory; business cycle literature Cooley (1995) and Cooley and Ohanian (1999); in the depression literature he cites Kehoe and Prescott (2002); in public finance, Christaino and Eichenbaum (1992), Baxter and King (1993); and in the stock market literature McGrattan and Prescott (2003) and Boldrin, Christian and Fisher (2001). The labor supply is consistent with Lucas and Rapping (1969), Lucas (1972), Kydland and Prescott (1982), Hansen (1985) and Auerbach and Kotlikoff (1987).

(4) It is hard to imagine a process for A_{it} in the Arab countries.[4] The stock of R&D stock and patents registered in the US are very low. Saudi Arabia, Egypt, Syria, Jordan, Kuwait and the UAE combined registered 367 patents in the US during the period from 1980 to 2000. Compare that to Korea which registered 6328 patents. Human capital stock and the quality of the human capital are questionable, see Development Challenges for the Arab Region: A Human Development Approach, UN (2009).

(5) When solving, an approximated Jacobian is used when linearizing the model. Then the approximation is updated each iteration by comparing the residuals, which result from the new trial value of the endogenous variables with the residuals of the linear equation. The method is not significantly different from Newton, but it runs faster. The innovations to stochastic equations are generated by drawing a set of random numbers from a standard normal distribution each period. These draws are scaled to match the variance-covariance system by multiplying the vector by its standard deviation because the covariance matrix is diagonal.

(6) The Penn table 6.2 data are only available to the year 2003 for the GCC countries.

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Appendix

Table 1:Actual and Predicted Labor Supply for the G7
and Arab non-oil Producing Countries

$$h = (1-\overline{\theta})/(1-\overline{\theta}) + (c/y)(\overline{\alpha}/1-\tau)$$

Estimates of the Labor Supply for the G7 (2000-2008)							
Country	Actual h	Predicted	Difference	α	θ	τ	c/y
Canada	25.26	23.60	1.66	1.78	0.38	0.38	0.70
France	20.08	22.73	-2.65	1.78	0.38	0.37	0.75
Germany	19.33	21.88	-2.54	1.78	0.38	0.42	0.73
Italy	21.09	22.45	-1.36	1.78	0.38	0.40	0.72
Japan	26.98	28.40	-1.41	1.78	0.38	0.25	0.66
UK	24.05	21.30	2.75	1.78	0.38	0.38	0.80
US	26.06	23.71	2.35	1.78	0.38	0.30	0.79
Average G7	**23.26**	**23.20**	**0.06**	**1.78**	**0.38**	**0.35**	**0.73**
Estimates of the Labor Supply for the Arab Countries (1999-2006)							
	Actual	Predicted	Frisch Elasticity	α	θ	τ	c/y
Egypt	NA	18.47	4.4	1.78	0.48	0.24	0.98
Jordon	NA	21.03	3.8	1.78	0.48	0.28	0.79
Morocco	NA	16.68	5.0	1.78	0.48	0.39	0.89
Syria	NA	26.10	2.8	1.78	0.48	0.19	0.67
Tunisia	NA	17.11	4.8	1.78	0.48	0.35	0.92
Average	**NA**	**19.87**	**4.1**	**1.78**	**0.48**	**0.28**	**0.85**

1. Both $\overline{\alpha}$ and $\overline{\theta}$ are the average values across G7 countries. The individual values of α for G7 which minimizes the error are 1.6 (Canada), 2.2 (France), 2.1 (Germany), 1.7 (Italy), 2.1 (Japan), 1.6 (UK) and 1.6 (USA) respectively. Same average value of α is adopted for the Arab countries.

Table 2: Productivity Decomposition of Arab Non-Oil Producing
Countries Relative to Average G7 – Sample 1999 to 2006

Hours are based on a value of $\alpha = 1.78$

Country	GDP per Person	GDP per Hour	Hours per Person
Egypt	15.80	21.48	73.55
Jordan	12.73	15.17	83.89
Morocco	15.90	23.97	66.32
Syria	6.21	5.94	104.6
Tunisia	22.06	32.43	68.03
G7	100.00	100.00	100.00

Table 3: Labor Supply with Natural Resource Endowment for Oil Producing Countries

$$\hat{h}^N = (1-\theta-\omega)/[(1-\theta-\omega)+(c/y)(\alpha/1-\tau)]$$

$(\alpha = 1.29)$

Low Hydrocarbon Revenue Period							High Hydrocarbon Revenue Period						
1991-1999							2000-2006						
	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	Difference in hours
Algeria	20.4	3.9	0.34	0.73	0.47	0.19	13.2	6.6	0.38	0.61	0.55	0.27	-12.6
Bahrain	25.8	2.9	0.05	0.73	0.49	0.19	18.8	4.3	0.05	0.72	0.53	0.26	-7.0
Kuwait	12.8	6.8	0.05	0.81	0.49	0.36	7.2	12.8	0.05	0.71	0.53	0.40	-5.6
Oman	21.7	3.6	0.05	0.83	0.49	0.22	9.8	9.2	0.05	0.73	0.53	0.37	-11.9
Qatar	15.4	5.5	0.05	0.78	0.49	0.33	13.1	6.6	0.05	0.42	0.53	0.39	-2.30
KSA	16.9	4.9	0.05	0.74	0.49	0.32	7.9	11.7	0.05	0.65	0.53	0.40	-9.0
UAE	26.0	2.8	0.05	0.63	0.49	0.23	19.6	4.1	0.05	0.65	0.53	0.27	-6.4
Average	**19.8**	**4.43**	**0.05**	**0.75**	**0.49**	**0.29**	**12.72**	**8.14**	**0.05**	**0.65**	**0.53**	**0.35**	**-7.83**

$(\alpha = 1.55)$

Low Hydrocarbon Revenue Period							High Hydrocarbon Revenue Period						
1991-1999							2000-2006						
	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	Difference in hours
Algeria	16.5	5.0	0.34	0.73	0.47	0.19	10.6	8.5	0.38	0.61	0.55	0.27	-5.9
Bahrain	21.2	3.7	0.05	0.73	0.49	0.19	15.2	5.6	0.05	0.72	0.53	0.26	-6.0
Kuwait	10.2	8.8	0.05	0.81	0.49	0.36	5.7	16.5	0.05	0.71	0.53	0.40	-4.5
Oman	17.6	4.7	0.05	0.83	0.49	0.22	7.7	11.9	0.05	0.73	0.53	0.37	-9.9
Qatar	12.4	7.1	0.05	0.78	0.49	0.33	10.5	8.6	0.05	0.42	0.53	0.39	-1.9
KSA	13.6	6.4	0.05	0.74	0.49	0.32	6.2	15.2	0.05	0.65	0.53	0.40	-7.4
UAE	21.4	3.7	0.05	0.63	0.49	0.33	15.9	5.3	0.05	0.65	0.53	0.27	-5.5
Average	**16.07**	**5.72**	**0.05**	**0.75**	**0.49**	**0.29**	**10.19**	**10.51**	**0.05**	**0.65**	**0.53**	**0.35**	**-5.0**

$(\alpha = 2)$

Low Hydrocarbon Revenue Period							High Hydrocarbon Revenue Period						
1991-1999							2000-2006						
	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	$\hat{h}^N$	Frisch	τ	c/y	θ	ω	Difference in hours
Algeria	13.3	6.5	0.34	0.73	0.47	0.19	8.40	10.9	0.38	0.61	0.55	0.27	-4.9
Bahrain	17.2	4.8	0.05	0.73	0.49	0.19	12.20	7.2	0.05	0.72	0.53	0.26	-5.0
Kuwait	8.1	11.4	0.05	0.81	0.49	0.36	4.50	21.4	0.05	0.71	0.53	0.40	-3.6
Oman	14.2	6.0	0.05	0.83	0.49	0.22	6.10	15.4	0.05	0.73	0.53	0.37	-8.1
Qatar	9.9	9.1	0.05	0.78	0.49	0.33	8.30	11.1	0.05	0.42	0.53	0.39	-1.6
KSA	10.9	8.2	0.05	0.74	0.49	0.32	4.90	19.5	0.05	0.65	0.53	0.40	-6.0
UAE	17.4	4.7	0.05	0.63	0.49	0.23	12.8	6.8	0.05	0.65	0.53	0.27	-4.4
Average	**12.96**	**7.38**	**0.05**	**0.75**	**0.49**	**0.29**	**8.11**	**13.56**	**0.05**	**0.65**	**0.53**	**0.35**	**-4.8**

θ is the share of capital. τ is the effective marginal tax rate; c/y is consumption to GDP ratio; $\hat{h}^N$ is equilibrium hours-worked predicted by the model; and ω is the share of hydrocarbon revenues in GDP.

Table 4: Taxes, Natural Resources and Labor Supply Projections for GCC
Average values

Country	Average Sample Data (1991-2003)			Base Run (2004-2050)			Policy I (2020 – 2050)				Policy II (2004 – 2050)		
	ω	σ_{ω}	c/y	h^N	ω	c/y	h^N	ω	$0.25\sigma_{\omega}$ in million USD	τ	h^N	ω	τ
Bahrain	0.22	0.04	72.5	16.4	0.25	71.0	17.1	0.24	153.3	0.05	15.7	0.25	0.095
Kuwait	0.38	0.07	83.7	11.4	0.35	64.3	12.5	0.33	1017.2	0.05	10.9	0.35	0.095
Oman	0.26	0.07	79.5	7.4	0.39	73.3	8.8	0.37	839.8	0.05	7.0	0.39	0.095
Qatar	0.37	0.07	65.7	13.4	0.36	39.2	14.8	0.35	351.7	0.05	12.8	0.36	0.095
KSA	0.32	0.04	70.7	16.2	0.29	60.4	17.0	0.28	3812.9	0.05	15.6	0.29	0.095
UAE	0.30	0.07	63.5	18.7	0.23	66.1	19.9	0.21	2187.5	0.05	18.0	0.23	0.095
GCC	**0.31**	**0.06**	**72.6**	**13.9**	**0.31**	**62.38**	**15.0**	**0.30**	**1393.7**	**0.05**	**13.6**	**0.31**	**0.095**

h_t^N is hours-worked (equation 10).

ω is the share of oil and gas (gas is converted into oil using the standard scale of 6.6).

σ_{ω} is the standard deviation of the natural resource revenues in GDP.

c/y is the consumption to GDP ratio.

τ is the tax rate.

Consumption and ω follow a random walk process over the simulation horizon from 2004 to 2050.

Policy I is the diversification policy, where the GCC manages to diversify by 2020, and reduce the share of hydrocarbon by $0.25\sigma_{\omega}$.

Policy II is a tax rate increase policy, where a 5% permanent increase in VAT (9.5 percent in the tax rate in equation 5).

Table 5: Lifetime Consumption Equivalent

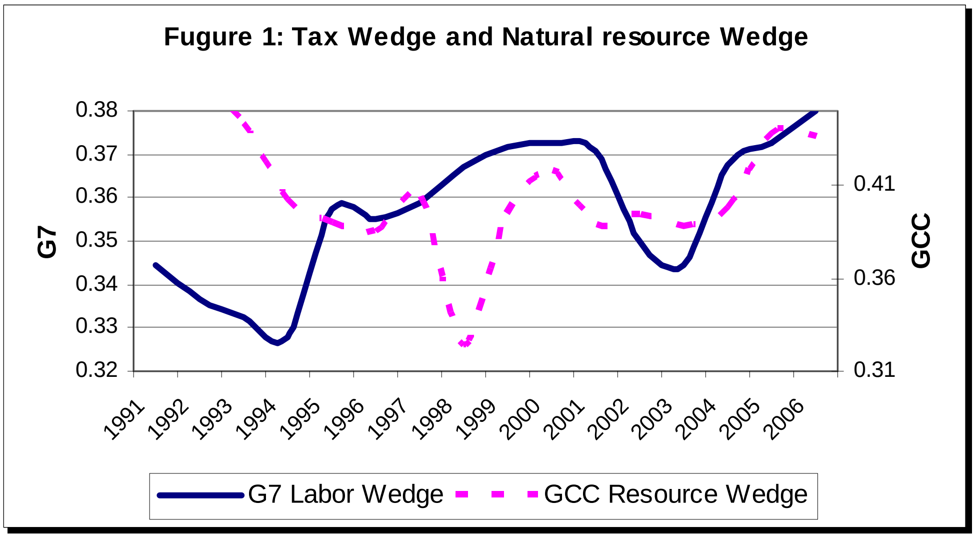
Country	Policy I	Policy II
Bahrain	3.87	- 4.79
Kuwait	9.29	- 4.80
Oman	13.99	- 3.77
Qatar	10.88	- 4.78
KSA	4.21	- 4.81
UAE	5.07	- 4.82

-Policy I is the diversification policy, where the share of hydrocarbon in GDP falls by 0.25 standard deviation from 2021 to 2050.
-Policy II is an introduction of a 5 percent permanent increase in VAT, which amounts to a 9.5 percent increase in the tax rate.

Table 6: Morocco's Poverty Reduction Policy Simulation

	Hours		GDP Per Capita		$\partial y / d\tau$	Income Multiplier	Δc_t^s	Poverty %
2007	Baseline	Policy	Baseline	Policy				21.59 [i]
2008	15.99	17.97	5682.52	6014.69	-1.27	5.85	2.26	20.48
2010	15.96	17.94	5905.58	6280.19	-1.15	6.34	2.58	18.27
2015	15.97	17.95	6487.00	6967.58	-0.94	7.41	1.69	14.72
2020	15.92	17.90	7076.94	7662.59	-0.81	8.28	1.20	10.50
2025	15.93	17.91	7703.77	8395.41	-0.72	8.98	2.68	7.57
2030	15.92	17.90	8356.12	9154.61	-0.66	9.56	1.51	5.61
2035	15.93	17.91	9042.68	9949.86	-0.62	10.03	1.74	4.01
2040	15.94	17.92	9767.29	10785.58	-0.58	10.43	1.37	2.92
2045	15.93	17.91	10527.96	11659.88	-0.56	10.75	1.31	2.11
2050	15.92	17.90	11328.41	12577.27	-0.53	11.02	1.46	1.54

i Actual data
-Data are in PPP 2005 base year. Real PPP GDP.
-$\partial y / d\tau$ is the tax multiplier, where an increase in the tax rate reduces income.
-$(y^s - y^b / y^b)100$ is the GDP multiplier, where the superscript s denotes simulation solution
value and b denotes the baseline simulation value.
-Δc_t^s is the consumption growth after policy.


Fugure 1: Tax Wedge and Natural resource Wedge
G7
GCC
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.41
0.36
0.31
1991
1992
1993
1994
1995
1996
1997
1998
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2000
2001
2002
2003
2004
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2006
G7 Labor Wedge
GCC Resource Wedge

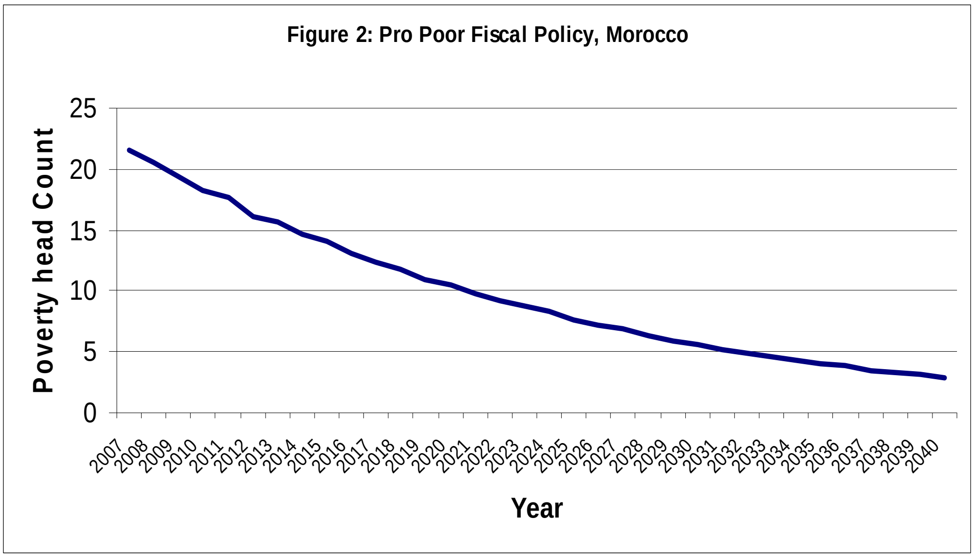
Figure 2: Pro Poor Fiscal Policy, Morocco
Poverty head Count
25
20
15
10
5
0
Year

Appendix 1 – Data

Average 2000-2008	Canada	France	Germany	Italy	Japan	UK	USA
General government final consumption expenditure, %GDP	19.24	23.31	18.70	19.62	17.86	20.54	15.58
Consumption of fixed capital, % GDP	13.01	13.00	14.89	15.28	20.62	11.26	11.85
Household final consumption expenditure, % GDP	55.84	56.46	58.47	59.04	57.08	64.88	70.03
Working Age Popualtion to Total Population	0.69	0.63	0.67	0.67	0.66	0.66	0.67
Employment to Age working population	0.72	0.65	0.67	0.58	0.75	0.71	0.72
Taxes individuals, % GDP	12.23	7.64	8.91	10.72	5.19	10.48	10.38
Social Security Contributions, Employees % GDP	2.01	4.02	6.11	2.30	4.28	2.64	3.00
Taxes on goods and services, % GDP	8.42	11.00	10.35	11.01	5.22	10.97	4.73
Military Expenditure, % GDP	1.20	2.46	1.38	1.92	0.97	2.46	3.76
τ_c	0.16	0.22	0.20	0.20	0.09	0.19	0.07
τ_{ss}	0.04	0.07	0.11	0.05	0.07	0.04	0.05
Capital Share	0.38	0.35	0.38	0.46	0.35	0.34	0.37
τ_{inc}	0.16	0.10	0.12	0.15	0.07	0.13	0.12
τ_h	0.28	0.23	0.30	0.28	0.18	0.26	0.25
τ	0.38	0.37	0.42	0.40	0.25	0.38	0.30
c/y	0.70	0.75	0.73	0.72	0.66	0.80	0.79
GDP Per Person, GDP Less IT in PPP 2005 divided By Population aged 15-64	42510.72	38698.09	37867.03	35733.27	40045.97	39364.55	57049.32

Source: OECD

Data Appendix (average 1991-2006)

Country	Actual Weekly Worked Hours	Capital Share	Consumption Output Ratio, PWT 6.2 (1991-2003/04)	Investment Ratio, PWT 6.2 (1991/03/04)	Population (Millions)	Labor force (Millions)	Employment (Millions)	Population Aged 15-64 % Total Population	Employment to Population Aged 15-64
Algeria		0.51	0.69	12.67	29.79	10.46	8.01	60.14	0.44
Bahrain		0.35	0.73	9.89	0.63	0.29	0.27	68.50	0.64
Egypt		0.45	0.96	5.41	64.91	19.24	17.35	58.89	0.45
Kuwait		0.57	0.84	10.67	2.05	1.08	1.09	70.99	0.74
Jordan		0.36	0.77	14.39	4.60	1.23	1.21	68.35	0.38
Morocco		0.56	0.90	11.52	27.76	9.56	8.55	60.67	0.51
Oman		0.53	0.80	9.30	2.29	0.82	0.76	59.81	0.55
Qatar		0.50	0.66	18.70	0.61	0.34	0.33	73.49	0.72
KSA		0.51	0.71	9.96	20.06	6.64	6.34	58.67	0.54
Syria		0.33	0.73	7.79	16.06	4.73	5.09	55.11	0.57
Tunisia		0.24	0.92	13.35	9.33	3.09	2.71	62.78	0.46
UAE		0.61	0.63	23.12	3.04	1.75	1.72	73.98	0.75
Source	ILO	UN	WDI-PWT	PWT	WDI	WDI	ILO	WDI	ILO

country	Employment to total population Ratio	Oil and Gas Reserves, Billions Barrels of Equivalent Oil	GDP Per Capita PPP PWT 6.2 (1991/03/04)	τ_c	τ_{ss}	τ_{inc}	$\tau_{inc}+\tau_{ss}$	τ	ω Share of Hydrocarbon Revenues
Algeria	0.27	38.0	4826.0	0.18	0.05	0.10	0.21	0.33	0.23
Bahrain	0.44	0.8	15562.4	0.00	0.04	0.01	0.05	0.05	0.22
Egypt	0.27	11.5	3955.0	0.09	0.05	0.08	0.17	0.24	
Kuwait	0.53	107.7	21698.5	0.00	0.04	0.00	0.04	0.04	0.32
Jordan	0.26		3835.6	0.16	0.04	0.08	0.16	0.28	
Morocco	0.31		3630.0	0.19	0.10	0.11	0.28	0.39	
Oman	0.33	9.7	13127.0	0.00	0.04	0.01	0.05	0.05	0.20
Qatar	0.53	113.6	23284.6	0.00	0.03	0.00	0.03	0.03	0.35
KSA	0.31	302.4	14086.7	0.00	0.06	0.00	0.04	0.04	0.25
Syria	0.31	4.3	1799.0	0.00	0.00	0.12	0.20	0.19	0.06
Tunisia	0.29	0.4	6296.2	0.22	0.05	0.08	0.16	0.31	0.04
UAE	0.56	137.8	24455.5	0.00	0.04	0.00	0.02	0.01	0.26
Source	ILO	BP	PWT	WDI, IFS	SS	WDI, IFS	Computed	Computed	WDI, IFS

ILO is the International Labor Organization
BP is British Petroleum
PWT is Penn World Table 6.3
WDI is World Bank
IFS is International Financial Stats, the IMF

Appendix 2 – Calculating the tax rate

Prescott (2004) adjusts the National Income Account to fit with economics theory, where households pay the taxes. The major adjustment is to treat "indirect taxes less subsidy" as "net taxes on final product". It means "net indirect tax" is not a cost component of GDP. Indirect taxes include value-added taxes, sales taxes, excise taxes, property taxes…etc, which mostly levied on households. Some indirect taxes such as diesel fuel taxes, property taxes on office buildings and sales taxes on equipments…etc fall on all forms of products. It is assumed that 2/3 of the indirect taxes less subsidy fall directly on private consumption expenditures, and the remaining 1/3 is distributed evenly over private consumption and private investment. The net indirect taxes on consumption, is $IT_c = [2/3 + 1/3 \frac{C}{C+I}] IT$, where C is private consumption expenditures, I is private investment, and IT is net indirect taxes. Consumption is $c = C + G - G_{mil} - IT_c$, where G is public consumption and G_{mil} is military spending. The GDP is given by $y = GDP - IT$. Prescott (2004) estimate of consumption tax rate is $\tau_c = \frac{IT_c}{C - IT_c}$. Regarding tax on labor income, Prescott (2004) has two: the income tax with a marginal tax rate τ_{inc} (which we argued earlier in the paper that its estimation is highly controversial), and a social security tax. The social security marginal tax rate $\tau_{ss} = \frac{social\,\sec urity\,taxes}{(1-\theta)(GDP - IT)}$, where the denominator is labor income if labor is paid its marginal productivity. The *average* income tax rate is $\bar{\tau}_{inc} = \frac{Direct\,Taxes}{GDP - IT - Depreciation}$, where direct taxes are paid by households and do not include corporate income taxes. Prescott's estimate of the marginal labor income tax $\tau_h = t_{ss} + 1.6\bar{\tau}_{inc}$ and the magic number 1.6 reflects the fact that the marginal income tax rates are higher than the average tax rates, and the number delivers a marginal income tax found in Feenberg and Coutts (1993) for the "US". Their calculation of the marginal income tax is based on a representative sample of tax records. They calculate by how much the tax revenue increases if every household labor income is increased by one percent. The total change in tax receipts divided by the total change in labor income is their estimate of the marginal income tax.

Sensitivity Analysis of the Effective Marginal Tax Rate Calculations

	Lower Bound Estimate			Central Estimate			Upper Bound Estimate				
Country	τ_1	h		τ_2	h		τ_3	h		τ_4	h
Algeria	0.28	17.8		0.33	16.8		0.41	15.1		0.50	13.1
Egypt	0.20	21.5		0.24	20.6		0.31	19.1		0.38	17.5
Jordan	0.24	24.4		0.28	23.4		0.34	21.9		0.41	20.0
Morocco	0.34	19.9		0.39	18.6		0.49	16.1		0.58	13.7
Syria	0.12	30.6		0.19	28.8		0.32	25.4		0.44	21.9
Tunisia	0.30	20.3		0.35	19.2		0.43	17.2		0.51	15.1
Average	**0.24**	**22.4**		**0.28**	**21.3**		**0.44**	**19.1**		**0.45**	**16.8**

τ_1 corresponds to a tax rate with $\tau_h = t_{ss} + 1\overline{\tau}_{inc}$

τ_2 corresponds to a tax rate with $\tau_h = t_{ss} + 1.6\overline{\tau}_{inc}$

τ_3 corresponds to a tax rate with $\tau_h = t_{ss} + 2.6\overline{\tau}_{inc}$

τ_4 corresponds to a tax rate with $\tau_h = t_{ss} + 3.6\overline{\tau}_{inc}$

See definitions of the social security tax and tax on income in the appendix. τ_{ss} τ_{inc}

$h = (1-\theta)/[(1-\theta) + (c/y)*(\alpha/1-\tau)]$ are hours-worked using predicting factors $\theta = 0.48$;

average Arab countries c/y and $\alpha = 1.55$

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